

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

COREPHOTONICS, LTD.,
Patent Owner.

IPR2018-01133
Patent 9,538,152 B2

Before MARC S. HOFF, BRYAN F. MOORE, and MONICA S.
ULLAGADDI, *Administrative Patent Judges*.

MOORE, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. *Background and Summary*

In this inter partes review, instituted pursuant to 35 U.S.C. § 314, Apple Inc. (“Petitioner”) challenge the patentability of claims 1–4 of U.S. Patent No. 9,538,152 B2 (“the ’152 patent,” Ex. 1001), owned by

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Corephotonics, Ltd. Paper 2 (“Pet.”). We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision, issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73, addresses issues and arguments raised during trial. For the reasons discussed below, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–4 of the ’152 patent are unpatentable.

B. Procedural History

On May 22, 2018, Petitioner filed a petition requesting an *inter partes* review of claims 1–4 of the ’152 patent pursuant to 35 U.S.C. §§ 311 *et seq.* Paper 2 (“Pet.”). Petitioner relies on the testimony of Dr. Oliver Cossairt. Ex. 1004. Patent Owner did not file a preliminary response.

On December 4, 2018, we instituted an *inter partes* review of the challenged claims. Paper 8 (“Decision on Institution” or “Dec. on Inst.”). On March 28, 2019, Patent Owner filed a Corrected Patent Owner Response. Paper 15. Petitioner relies on the testimony of Dr. James Kosmach. Ex. 2005. Ex. 2005. On June 3, 2019, Petitioner filed a Reply. Paper 19 (“Reply”). A hearing was held on October 8, 2019. A transcript of the hearing has been entered into the record. Paper 32 (“Tr.”).

C. Real Parties in Interest

Petitioner indicates that Apple Inc. is the only real party in interest. Pet. 1. Patent Owner does not contest this indication.

D. Related Matters

A decision in this proceeding could affect or be affected by the following case pending in the United States District Court for the Northern District of California and involving the ’152 patent: *Corephotonics, Ltd. v. Apple Inc.*, Case No. 5-17-cv-06457 (N.D. Cal.). Pet. 2; Paper 4, 2 (Patent Owner also asserts *Corephotonics, Ltd. v. Apple Inc.*, Case No. 5:18-cv-

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02555 (N.D. Cal.) may affect, or be affected by, a decision in this proceeding).

E. The '152 Patent

The '152 patent is directed to “multi-aperture imaging (‘MAI’) systems with high color resolution and/or optical zoom.” Ex. 1001, 1:15–18. The '152 patent states that while mechanical zoom solutions are common in digital still cameras, they are “typically too thick for most camera phones” and may result in “resolution compromise.” *Id.* at 1:35–43. In its background, the '152 patent states that one of the known approaches is using a multi-aperture imaging (“MAI”) system, for example, a dual-aperture imaging system (“DAI”) including “two optical apertures which may be formed by one or two optical modules, and one or two image sensors” for “implementing zoom, as well as increasing the output resolution.” *Id.* at 1:52–59.

The Specification states that those known multi-aperture imaging systems “often trade-off functionalities and properties, for example zoom and color resolution, or image resolution and quality for camera module height,” and therefore, there was a need to have thin multi-aperture imaging systems that “produce an image with high resolution (and specifically high color resolution) together with zoom functionality.” *Id.* at 1:63–66, 1:67–2:3.

As a solution to this problem, the '152 patent describes a dual aperture imaging system including a Wide sensor and a Tele sensor capturing a Wide image and a Tele image from two apertures, where color filter arrays may be used in the Wide sensor and Tele sensor. *Id.* at 2:34–65. The Wide image and Tele image may be fused to “output one fused (combined) output zoom

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image processed according to a user [zoom factor] ZF input request.” *Id.* at 3:17–20.

The ’152 patent describes a dual-aperture zoom imaging system 100 including a Wide subset 104 and a Tele subset 106 each having a respective sensor. *Id.* at Figs. 1A, 1B. The ’152 patent explains that a processor 108 “fuses . . . a Wide image obtained with the Wide subset and a Tele image obtained with the Tele subset, into a single fused output image according to a user-defined ‘applied’ ZF input or request.” *Id.* at 5:60–6:2. The ’152 patent explains that an overlap area 110 of the Wide image and Tele image is illustrated on the Wide image in the figure. *Id.* at 4:62–64, 6:2–9.

To obtain the output image, the ’152 patent teaches a registration process, which “chooses either the Wide image or the Tele image to be a primary image . . . based on the ZF chosen for the output image.” *Id.* at 9:20–21, 31–33. The registration process “considers the primary image as the baseline image and registers the overlap area in an auxiliary image to it,” and the “output image point of view is determined according to the primary image point of view (camera angle).” *Id.* at 9:20–28.

F. Illustrative Claims

Independent claim 1, reproduced below, is illustrative of the claimed subject matter:

1. A multi-aperture imaging system comprising:

a first camera that provides a first image, the first camera having a first field of view (FOV₁) and a first sensor with a first plurality of sensor pixels covered at least in part with a standard color filter array (CFA);

a second camera that provides a second image, the second camera having a second field of view (FOV₂) such that FOV₂<FOV₁ and a second sensor with a second plurality of

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sensor pixels being either Clear or covered with a standard CFA, the second image having an overlap area with the first image; and

a processor configured to provide an output image from a point of view of the first camera based on a zoom factor (ZF) input that defines a respective field of view (FOV_{ZF}), the first image being a primary image and the second image being a non-primary image, wherein if $FOV_2 < FOV_{ZF} < FOV_1$ then the point of view of the output image is that of the first camera, the processor further configured to register the overlap area of the second image as a non-primary image to the first image as primary image to obtain the output image.

Ex. 1001, 12:60–13:13.

G. Evidence

Petitioner relies on the following references. Pet. 14–27.

Name	Reference	Exhibit
Border	US Patent Application Pub. No. 2008/0030592 A1, filed Aug. 1, 2006, published Feb. 7, 2008.	1006
Parulski	US Patent No. 7,859,588 B2, filed Mar. 9, 2007, issued Dec. 28, 2010	1007

H. Prior Art and Asserted Grounds

Petitioner asserts that claims 1–4 would have been unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–4	103	Border and Parulski

Pet. 12.

II. ANALYSIS

A. Legal Standards

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject

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matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations, including commercial success, long-felt but unsolved needs, failure of others, and unexpected results.¹ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966) (“the *Graham* factors”).

B. Level of Ordinary Skill in the Art

For an obviousness analysis, prior art references must be “considered together with the knowledge of one of ordinary skill in the pertinent art.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (quoting *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). Moreover, “it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom.” *In re Preda*, 401 F.2d 825, 826 (CCPA 1968). That is because an obviousness analysis “need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *KSR*, 550 U.S. at 418 (Fed. Cir. 2007); *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1259 (Fed. Cir. 2007).

¹ Patent Owner does not put forth evidence it alleges tends to show secondary considerations of non-obviousness in its Patent Owner Response.

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Petitioner asserts a person of ordinary skill in the art of the subject matter of the '152 patent at the time of the invention would have had a

bachelor's or the equivalent degree in computer science or electrical and/or computer engineering or a related field and 2-3 years of experience in imaging systems including optics design and imaging processing [and] a person with less formal education but more experience, or more formal education but less experience, could have also met the relevant standard for a [person of ordinary skill in the art of the subject matter of the '152 patent at the time of the invention.]

Pet. 9 (citing Ex. 1004 ¶ 19). We adopt Petitioner's articulation of the level of skill and acknowledge that the level of ordinary skill in the art is also reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995); *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978).

C. Claim Construction

In an *inter partes* review based on a petition filed prior to November 13, 2018, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. *See* Trial Practice Guide, 77 Fed. Reg. at 48,766; 37 CFR § 42.100(b). Consistent with the broadest reasonable construction, claim terms are presumed to have their ordinary and customary meaning as understood by a person of ordinary skill in the art in the context of the entire patent disclosure. *In re Translogic Tech.*, 504 F.3d at 1257.

Petitioner did not offer a construction for the term "point of view" in the Petition. Pet. 10–11. Patent Owner asserts that "point of view" should be construed as "camera angle." PO Resp. 13. The Specification states that "[t]he output image point of view is determined according to the primary camera point of view (camera angle). *Id.* (citing Ex. 1001, 9:26–28).

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Nevertheless, Petitioner asserts “[t]o the extent the Board adopts Patent Owner’s proposed construction of ‘point of view’ as ‘camera angle,’ such a construction does not materially change Petitioner’s analysis.” Reply 1. We agree that this construction does not change the analysis in this case.

Patent Owner, in its Sur-Reply, asserts its construction is more consistent with the extrinsic evidence and the “inventor’s usage of the term” than Petitioner’s construction of “viewpoint.” Sur-Reply 2. We do not agree that Petitioner’s contentions rely on a construction of “point of view” as “viewpoint.” Thus, we do not view this case as requiring a choice between two constructions.

Patent Owner has not explained how construing “point of view” as “camera angle” serves to resolve any controversy regarding obviousness. Additionally, the claims recite “the point of view of the output image is that of the first camera.” Thus, a construction of camera angle is redundant to the words of the claim.

In view of our analysis below, we determine that no claim terms require express construction. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (Only terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy).

D. Obviousness over Border and Parulski

Petitioner asserts that claims 1–4 are unpatentable under 35 U.S.C. § 103 over Border (Ex. 1006) and Parulski (Ex. 1007). Pet. 14–70.

Petitioner asserts that Border is a US patent application filed on August 1, 2006 and published on February 7, 2008 and Parulski was filed on March 9, 2007, published on September 11, 2008, and issued on December 28, 2010. Pet. 12. Petitioner asserts further that these references are prior

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art to the '152 patent under at least 35 U.S.C. § 102(b). *Id.* The '152 patent is a National Phase application from PCT patent application PCT/IB2013/060356 filed November 23, 2013 which claims priority from US Provisional Application No. 61/730,570, filed November 28, 2012. Ex. 1001. The '152 patent issued on January 3, 2017. *Id.* We are persuaded that Border and Parulski are prior art.

a) Overview of Border

Border describes providing a digital camera with an extended zoom range without unduly increasing the size or cost of the digital camera “while providing good perceived image quality throughout the zoom range.” Ex. 1006 ¶ 10. As shown in Figure 5 of Border, reproduced below, the processor of a digital camera includes an image compositor 202 to form a composite image 208 using the two images, wide image 204 and telephoto image 206 of the same scene, that are captured using lenses having different focal lengths. *Id.* ¶ 70.

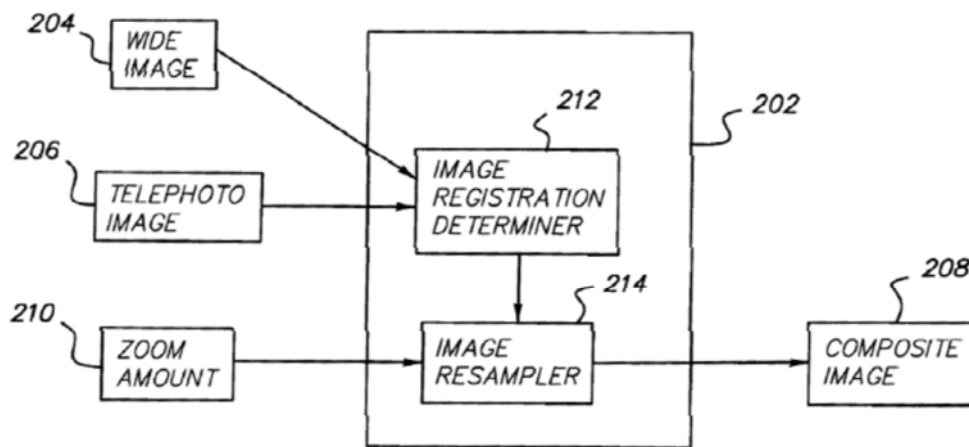


FIG. 5

As seen in Figure 5, above, the image registration determiner 212 determines the registration between the wide image 204 and the telephoto image 206, so that the two images are matched to “locate the high-resolution

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image accurately into the low-resolution image and then stitched into place so the edge between the two images in the composite image is not discernible.” *Id.* ¶ 29, Fig. 5. Border goes on to explain that in the context of Figure 5, telephoto image 206 captures a smaller portion of the scene, but with greater resolution than wide image 204. *Id.* ¶ 36.

Border also describes that an image resampler 214 of the processor produces the composite image 208 based on a zoom amount Z specifying the desired relative zoom amount of the produced composite image 208. *Id.* ¶ 43. Specifically, Border explains that the composite image 208 is generated from the two images and that the resulting composite image is produced differently for different zoom amount values, such as $Z=1$, $1<Z<M$, and $Z=M$, where M is the relative magnification ratio M of the telephoto image 206 to the wide image 204. *Id.* ¶¶ 29, 44.

2. Overview of Parulski

Parulski “utilizes one of the images from a dual-lens camera as a secondary image that can be used to modify the other, primary image and thereby generate an enhanced primary image.” Ex. 1007, 7:32–35. Specifically, Parulski discloses that examples of the enhancement to the primary image include “to sharpen portions of the primary image,” “to modify the dynamic range of the primary image,” or “to replace portions of the primary image (areas of lower noise but with some motion blur) with corresponding portions of the secondary image (areas of higher noise but little or no motion blur) to obtain a modified image with relatively low noise and good sharpness.” *Id.* at 7:54–8:5, Fig. 26.

Parulski describes determining the primary image and secondary image from two capture units of the digital camera based on a requested zoom position provided by a user. *Id.* at 27:8–24, Fig. 23. For example, if

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the requested zoom position is not within the zoom range of the current primary capture unit for providing a primary image, “the functions of the capture units are reversed” by switching the capture unit for providing a secondary image and the capture unit for providing the primary image. *Id.* at 27:8–15.

3. *Analysis of Claims 1 and 3*

In discussing claim 3, Petitioner refers to its contentions for claim 1. Pet. 66–69. Patent Owner does not separately argue claim 3. PO Resp. 19. Therefore, our discussion of the limitations of claim 1 is applicable to claim 3.

Petitioner provides reasons to combine Border and Parulski including: (1) “Border and Parulski are analogous prior art and are in the same field of endeavor pertaining to a digital camera that uses multiple lenses and image sensors to provide an enhanced output image” (*id.* at 18), (2) “When evaluating the teachings of Border, a POSITA would naturally have considered the teachings of Parulski, which is a patent that has the same co-inventor (John N. Border) and the same assignee (Eastman Kodak Company, one of the top digital camera makers) as Border” (*id.* at 19), and (3) “Parulski explicitly provides that its image augmentation process of using a secondary image to modify a primary image ‘can also be applied in connection with image pairs having different resolutions[]’” and “refers to Border’s system as an example for such application, and explicitly incorporates Border by reference” (*id.* at 18, 20).

a) *Preamble*

The preamble of independent claim 1 recites, “[a] multi-aperture imaging system.” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends Border’s digital camera 10B

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teaches a multi-aperture imaging system. Pet. 20–21 (citing Ex. 1006 ¶¶ 36, 58, 59, Fig. 1B; Ex. 1002 ¶¶ 63–65).

Independent claim 1 further recites “a first camera that provides a first image.” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends that Border describes a digital camera 10B including two fixed focal length lenses 2 and 4 “each providing an image to a corresponding image sensor 12 and 14” (Ex. 1006 ¶ 58), as such, Border’s wide camera, including fixed focal length lens 2 and corresponding image sensor 12, corresponds to “a first camera that provides a first image” as recited in claim 1. Pet. 23–25 (citing Ex. 1006 ¶¶ 36, 58; Ex. 1002 ¶¶ 67–69).

b) “the first camera having a first field of view (FOV₁)”

Independent claim 1 further recites “the first camera having a first field of view (FOV₁).” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends that Border teaches that its fixed focal length lens 2 has a first field of view (FOV₁) and describes that in an image capture device (e.g., digital camera 10B), “two or more lens systems are associated with a respective number of image sensors. The lenses have different focal lengths and different fields of view within the same scene wherein the field of view of the longer focal length lenses contains at least a portion of the field of view of the shorter focal length lens.” Pet. 25–26 (citing EX. 1006 ¶¶ 25, 31; Ex. 1002 ¶¶ 71–72).

c) “a first sensor with a first plurality of sensor pixels . . .”

Independent claim 1 further recites “[the first camera having] a first sensor with a first plurality of sensor pixels covered at least in part with a standard color filter array (CFA).” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends that Border

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teaches that its wide camera includes image sensor 12, which “includes an array of discrete light sensitive picture elements overlaid with a color filter array (CFA) pattern to produce color image data corresponding to the CFA pattern,” (Ex. 1006 ¶ 60) and Border teaches that its sensors 12 and 14 are “single-chip color Megapixel CCD sensors, using the well-known Bayer color filter pattern to capture color images.” (*id.* ¶ 32). Pet. (citing Ex. 1006 ¶¶ 32, 60; Ex. 1002 ¶¶ 74–78).

d) “a second camera that provides a second image”

Independent claim 1 further recites “a second camera that provides a second image.” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends that Border describes that “the image processor 50 of FIGS. 1A and 1B contains an image compositor 202 that receives both the wide image 204 from the fixed focal length lens 2 and the telephoto image 206 from the zoom lens 3.” Pet. 28 (citing Ex. 1006 ¶ 36). Although some of the description in paragraph 36 of Border references a Figure 1A embodiment in which the telephoto image 206 is from the zoom lens 3, Petitioner contends that a person of ordinary skill in the art would have understood that in the corresponding example of Figure 1B, image processor 50 receives the telephoto image 206 from fixed focal length lens 4 (Ex. 1006 ¶¶ 36, 58 Figs. 1B, 5; Ex. 1002 81). Pet. 28–30 (citing Ex. 1006, 36, 58; Ex. 1002 ¶¶ 79–82).

e) “the second camera having a second field of view (FOV_2) such that $FOV_2 < FOV_1$ ”

Independent claim 1 further recites “the second camera having a second field of view (FOV_2) such that $FOV_2 < FOV_1$.” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends that Border teaches that its fixed focal length lens 4 has a second

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field of view (FOV_2) such that $FOV_2 < FOV_1$ because Border describes that in its image capture device, “two or more lens systems are associated with a respective number of image sensors. The lenses have different focal lengths and different fields of view within the same scene wherein the field of view of the longer focal length lenses contains at least a portion of the field of view of the shorter focal length lens.” Pet. 31 (citing Ex. 1006 ¶ 25). And, in Border’s digital camera 10B of Figure 1B, the fixed focal length lens 4 is the longer focal length lens and the fixed focal length lens 2 is the shorter focal length lens, for example, “[t]he two fixed focus lenses are selected to provide a substantial zoom range, for example, 3:1 wherein the focal length of the second fixed focal length lens 4 is $3\times$ as long as the fixed focal length lens 2” (Ex. 1006 ¶ 58). Pet. 31–32. As such, according to Petitioner, because the FOV_2 of the longer focal length lens 4 “contains at least a portion of” FOV_1 of the shorter focal length lens 2, a POSITA would have understood that FOV_2 is less than FOV_1 . Pet. 31–35 (with further detailed explanation, citing Ex. 1006 ¶¶ 25, 47, 58, Fig. 6; Ex. 1002 ¶ 85–90).

f) *“a second sensor with a second plurality of sensor pixels . . .”*

Independent claim 1 further recites “[the second camera having] a second sensor with a second plurality of sensor pixels, the second plurality of sensor pixels being either Clear or covered with a standard CFA.” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends Border teaches that its tele camera includes an image sensor 14, which “includes an array of discrete light sensitive picture elements overlaid with a color filter array (CFA) pattern to produce color image data corresponding to the CFA pattern” (Ex. 1006 ¶ 60) and Border teaches that sensors 12 and 14 are “single-chip color Megapixel CCD sensors, using the well-known Bayer color filter pattern to capture color

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images” (*id.* ¶ 32). Pet. 36–37 (citing Ex. 1006 ¶¶ 32, 60; Ex. 1002 ¶¶ 91–95).

g) “*the second image having an overlap area with the first image*”

Independent claim 1 further recites “the second image having an overlap area with the first image.” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends that Border describes that in its image capture device, “[t]he lenses have different focal lengths and different fields of view within the same scene wherein the field of view of the longer focal length lenses contains at least a portion of the field of view of the shorter focal length lens” (Ex. 1006 ¶ 25) and a person of ordinary skill in the art would have understood that the region 220 in Figure 6 of Border below corresponds to the overlap area of the telephoto image 206 (e.g., the entire area of the telephoto image 206) with the wide image 204 (*id.* ¶ 32; Ex. 1002 ¶ 98). Pet. 37–39 (citing Ex. 1006 ¶¶ 25, 47; Ex. 1002 ¶¶ 96–100).

h) “*a processor configured to provide an output image from a point of view of the first camera . . .*”

Independent claim 1 further recites “a processor configured to provide an output image from a point of view of the first camera based on a zoom factor (ZF) input that defines a respective field of view (FOV_{ZF}).” Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends Border teaches a processor configured to provide an output image from a point of view of the first camera based on a zoom factor (ZF) input that defines a respective field of view (FOV_{ZF}) and provides a detailed explanation of its contention. Pet. 39–48 (citing Ex. 1006 ¶¶ 28, 29, 36–40, 42, 44, 48, 53, 58, 64, 66, Figs. 1B, 5; Ex. 1010 (Szeliski - as support

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for meaning of homography), 50–51, Fig. 2.12; Ex. 1008 (Jacobson - as support for meaning of homography), 5, 57–58; Ex. 1002 ¶¶ 101–115).

- i) “the first image being a primary image and the second image being a non-primary image”*

Independent claim 1 further recites “[processor configured to provide an output image from a point of view of the first camera based on a zoom factor (ZF) input that defines a respective field of view (FOV_{ZF}),] the first image being a primary image and the second image being a non-primary image.” Petitioner has shown sufficiently that the combination of Border and Parulski teach this limitation of claim 1. Petitioner contends Border in combination with Parulski renders obvious the limitation that that the processor is configured to provide an output image from a point of view of the first camera based on a zoom factor (ZF) input that defines a respective field of view (FOV_{ZF}), the first image being a primary image and the second image being a non-primary image and provides a detailed explanation of its contention. Pet. 39–48 (citing Ex. 1006 ¶¶ 44; Ex. 1007 (Parulski), 7:32–35, 7:54–8:5, 23:28–40, 53–58, 27:8–15, 25–31, 28:33–40, 45–67, 29:51–67, 15A, 15B, 16A, 16B, 23, 26; Ex. 1008 (Jacobson - as support for motivation to combine), 5, 57–58; Ex. 1010 (Szeliski - as support for motivation to combine), 50–51, Fig. 2.12; Ex. 1002 ¶¶ 116–123). For example, Petitioner contends that “[a]lthough Border does not expressly use ‘primary image’ and ‘non-primary image’ labels, Parulski, in an analogous context, uses the labels ‘primary image’ and ‘secondary image’ to describe the roles of respective images used in forming a composite image.” Pet. 49.

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j) “wherein if $FOV_2 < FOV_{ZF} < FOV_1$ then the point of view of the output image is that of the first camera”

Independent claim 1 further recites “wherein if $FOV_2 < FOV_{ZF} < FOV_1$ then the point of view of the output image is that of the first camera.”

Petitioner has shown sufficiently that Border teaches this limitation of claim 1. Petitioner contends that Border teaches a zoom amount 210 Z that defines a respective field of view (FOV_{ZF}) (Ex. 1002 ¶ 125) and Border teaches providing a composite image 208 from a point of view of the wide camera (first camera) when the zoom amount 210 Z is between 1 and M, M being the relative magnification ratio of the telephoto image 206 to the wide image 204 (*id.*), thus, because FOV_{ZF} defined by the zoom amount 210 Z between 1 and M is between FOV_1 and FOV_2 , Border teaches that if $FOV_2 < FOV_{ZF} < FOV_1$ then the point of view of the output image is that of the first camera as claimed (*id.* at ¶ 126). Pet. 55–56 (citing Ex. 1002 ¶¶ 124–130).

Patent Owner’s Contentions

Patent Owner asserts that “Border fails to discuss any concept of creating an output image from the images of multiple cameras that is from the **point of view** of any **specific** camera.” PO Resp. 19–20. Patent Owner also asserts that Petitioner’s contentions are limited to the situation in which $Z=1$ and the composite image is the same as the wide angle image and no zoom is used. PO Resp. 25–26. According to Patent Owner, Petitioner’s contentions are not applicable to a situation in which $FOV_2 < FOV_{ZF} < FOV_1$. *Id.* We disagree.

According to the Petition, “when the zoom amount 210 Z is between 1 and M, data from both the wide image 204 and the telephoto image 206 are used by the image resampler 214 to produce the composite image 208.” Pet.

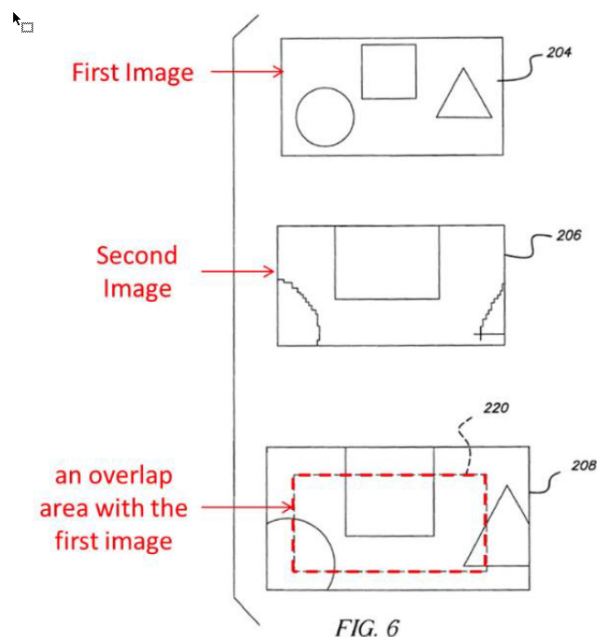
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44. This contention is consistent with and within the range $FOV_2 < FOV_{ZF} < FOV_1$ that Patent Owner asserts the Petition does not cover. Thus, we are not persuaded by Patent Owner's argument.

Patent Owner also asserts that the method by which Border combines images, i.e. "stitching," does not result in a composite image from the point of view of a single camera. PO Resp. 20. According to Patent Owner, Petitioner admits "Border discusses prior art 'image stitching' techniques wherein 'two images are matched to 'locate the high resolution image accurately into the low-resolution image and then stitched into place so the edge between the two images in the composite image is not discernible.'" PO Resp. 20 (citing Pet. 44). This quote from the Petition, according to Patent Owner, means that Border only combines the two images at the edge between the two images and nowhere else.

Patent Owner provides an annotated version of Fig. 6 of Border reproduced below.



(APPL-1006), Border, Fig. 6, annotated

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Annotated Figure 6, above, shows a first image, second image and combined image produced by Border. Ex. 1006, Fig. 6. Patent Owner asserts that the area outside the dashed-line border is from the perspective of the first image and the area inside the dashed-line border is from the perspective of the second image. PO Resp. 21.

Petitioner refutes Patent Owner's contention that "stitching" involves the straightforward combining of two images by using one image inside a border and another image outside the border without transposing either image so it is from the perspective of the other. Reply 3. Petitioner contends, in the Petition, that Border uses registration to "in the form of homography H_{TW} that **transforms the coordinates of the telephoto image 206 to the wide image 204.**" *Id.* (citing Pet. 46–47 (quoting Ex. 1006 ¶¶ 38–39)). Petitioner relies on its declarant who testifies that registration in Border, which "transforms the coordinates of the telephoto image 206 to the wide image 204," (Ex. 1006 ¶ 38) has the effect of making the telephoto portion of the composite image has the same point of view as the wide image 204. Reply 3–4 (citing Pet. 43–48 (citing Ex. 1004 [Coissart Decl.] ¶ 114)).

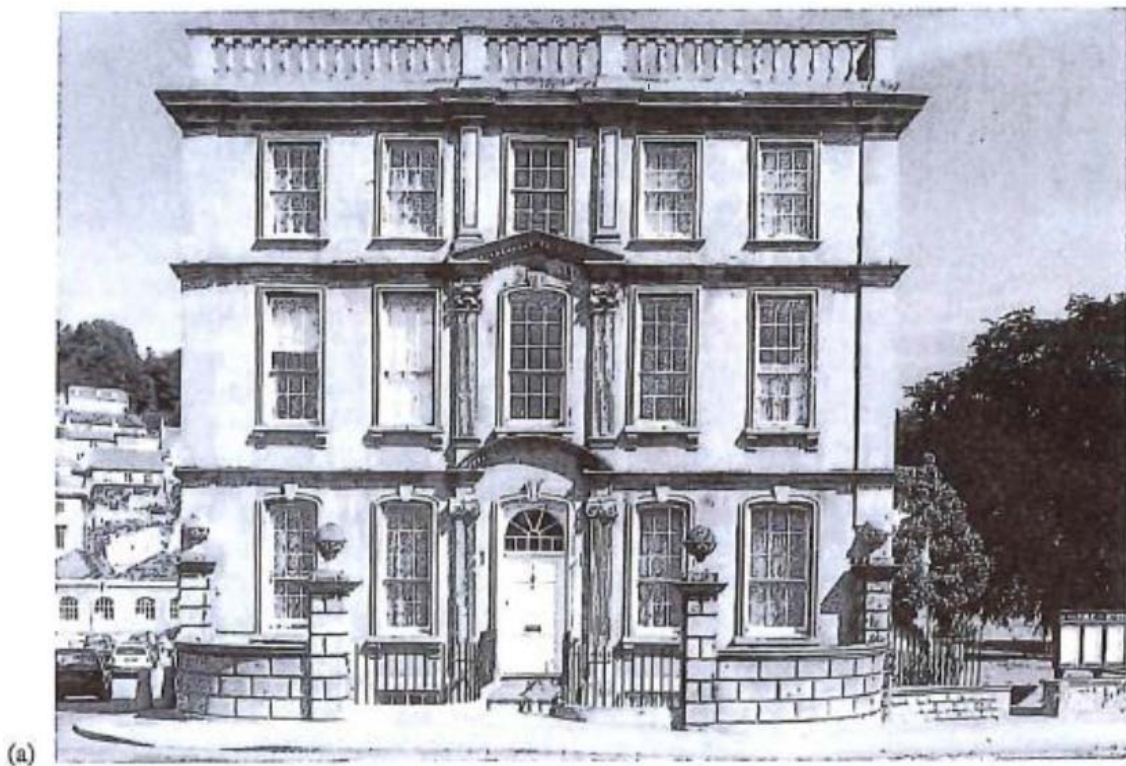
This assertion is supported by evidence in form of references that further explain that stitching can use registration that implements homography, which transforms an image to the point of view of another associated image. Ex. 1004 ¶ 114 (citing Ex. 1010 [Szeliski] Fig. 2.12, 50–51; Ex. 1008 [Jacobson] 5, 57–58). We credit Petitioner's declarant on this contention. Patent Owner's declarant admitted he did not have an understanding of stitching: "[Q.] So as you sit here today, you don't know what image stitching includes and does not include because you're not an expert in that area, correct? [A.] That – that's fair to say, yes." Ex. 1011,

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164:9–13. Thus, we give Patent Owner’s declarant’s testimony on this issue less weight.

Patent Owner suggests that Petitioner’s declarant is incorrect because the homography of Border cannot take into account image transformations in which features are occluded in one of the two images to be combined. PO Resp. 22. Patent Owner further asserts “the shape and perspective of objects captured in the images, where one portion of an object would be occluded in the image captured by one sensor but not included in the image captured by another sensor in the system.” *Id.* Patent Owner includes two images from Figure 4.24 of the Jacobson textbook (Ex. 1008) to show “occlusions.”



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Figure 4.24 Perspective and viewpoint. (a) Distant central viewpoint. (b) Closer oblique viewpoint

Figure 4.24 of the Jacobson textbook (Ex. 1008) is reproduced above. The Figure shows occluded features such as left side of the building in the second image which is not visible in the first image. Patent Owner asserts that “homography cannot change these characteristics of an image taken from one point of point of view to match those of the scene from a different point of view.” PO Resp. 23.

Patent Owner contends that Border must perform a transformation that accounts for occlusions in order to result in a composite image that is

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from the point of view of a single camera, as recited in the claims. We determine that occlusions are not explicitly recited in the claims or recited in the Specification such that they could be properly imported from the '152 Specification. Thus, we decline to import a limitation to resolving “occlusions” into the claims.

The effect of Patent Owner’s argument would be to require more detail from Border than is found in the '152 Specification on the issue of occlusions. We do not agree with this approach to construing the “point of view” limitation. *See Motorola, Inc. v. Interdigital Tech. Corp.*, 121 F.3d 1461, 1471 (Fed. Cir. 1997) (finding a reference is enabled when “the reference itself provides block diagrams at a level of detail similar to those contained in the patent”).

To support its reading of the claims, Patent Owner also asserts that the '152 patent Specification discloses two problems with combining wide and telephoto images, i.e. “parallax [i.e., differences in images due to point of differing points of view] and color resolution artifacts inherent in prior art MAI systems.” PO Resp. (citing Ex. 1001, 2:6–11). Although Patent Owner cites to parallax issues as an artifact eliminated by the invention of the '152 patent, the Specification states only that “[a] primary source of these artifacts is the image registration process, which has to find correspondences between different images that are often captured by different sensor with different color filter arrays (CFAs).” Ex. 1001, 2:6–11. Thus, although the Specification of the '152 patent broadly discuss parallax artifacts as “correspondences between different images,” it does not extensively discuss parallax artifacts.

To that point, the process of resolving the differences in point of view is described in the Specification as follows:

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The registration process chooses either the Wide image or the Tele image to be a primary image. The other image is defined as an auxiliary image. The registration process considers the primary image as the baseline image and registers the overlap area in the auxiliary image to it, by finding for each pixel in the overlap area of the primary image its corresponding pixel in the auxiliary image. The output image point of view is determined according to the primary image point of view (camera angle). Various correspondence metrics could be used for this purpose, among which are a sum of absolute differences and correlation.

Ex. 1001, 9:22–30. In other words, other than stating that finding corresponding pixels and outputting an image from the “primary image point of view” is required, the ’152 Specification does not describe how outputting and image from the “primary image point of view” is accomplished.

It is correct that images taken from two points of view may have occlusions. *See* Ex. 1008, Fig. 4.24. Nevertheless, the ’152 patent does not describe occlusions or propose any solution to addressing the issue of occlusions. The fact that the ’152 patent says a composite image must be of a particular point of view, without more, does not mean that every problem associated with differing points of view must be solved in order to meet the claim limitation. “[C]laims need not recite every component necessary to enable operation of a working device.” *Rambus Inc. v. Infineon Tech. AG*, 318 F.3d 1081, 1093 (Fed. Cir. 2003). “That a device will only operate if certain elements are included is not grounds to incorporate those elements into the construction of the claims. A claim to an engine providing motive power to a car should not be construed to incorporate a limitation for an exhaust pipe, though an engine may not function without one.” *Markem-Imaje Corp. v. Zipher Ltd.*, 657 F.3d 1293, 1301 (Fed. Cir. 2011).

We do not determine that the claim requires resolution of all issues associated with “artifacts” associated with combining images from differing

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points of view. Border specifically states that it “transforms the coordinates of the telephoto image 206 to the wide image 204.” Ex. 1006 ¶ 38. Patent Owner asserts that this is “stitching” which is outside the scope of the claims (PO Resp. 20) but neither the claims nor the Specification of the ’152 patent disavow “stitching.” *See generally*, Ex. 1001. As noted above, the Specification states broadly that artifacts associated with using different sensors with different CFAs are corrected by the invention. Ex. 1001, 2:4–11. Neither party argues that Border does not address issues related to CFAs as required by the claims. On the other hand, the Specification does not mention problems associated with occlusions. Thus, we are not persuaded by this argument.

We are persuaded that Border’s express disclosure of transforming coordinates from the telephoto to the wide image along with the testimony of Petitioner’s declarant, which is supported by the Jacobson and Szeliski references, is sufficient to meet the limitation to “wherein if $FOV_2 < FOV_{ZF} < FOV_1$ then the point of view of the output image is that of the first camera.”

k) *“the processor further configured to register the overlap area of the second image . . .”*

Independent claim 1 further recites “the processor further configured to register the overlap area of the second image as non-primary image to the first image as primary image to obtain the output image.” Petitioner has shown sufficiently that the combination of Border and Parulski teach this limitation of claim 1. Petitioner contends that Border in combination with Parulski renders obvious that the processor is further configured to register the overlap area of the second image as non-primary image to the first image

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as primary image to obtain the output image and provides a detailed explanation of its contention. Pet. 57–62 (citing Ex. 1006 ¶¶ 36–40, 43, 45, 47, 48, Fig. 5; Ex. 1007 (Parulski), 7:32–35, 7:54–8:5, 29:51–67; Ex. 1010 (Szeliski - as support for motivation to combine), 50–51, Fig. 2.12; Ex. 1002 ¶¶ 131–142). For example, Petitioner contends that a person of ordinary skill

would have understood that Border establishes a primary/non-primary relationship between first image and second image as claimed, though without express usage of the ‘primary image’ and ‘non-primary image’ labels. However, Parulski, in an analogous context, uses the labels ‘primary image’ and ‘secondary image’ to describe the roles of respective images used in forming a composite image.

Pet. 57–58.

Similar to its arguments regarding the “point of view” limitation above, Patent Owner argues that registering the overlap region in the ’152 patent requires more than transforming coordinates. PO Resp. 27. The ’152 patent discloses that the “registration process considers the primary image as the baseline image and registers the overlap area in the auxiliary image to it” by finding corresponding pixels in the overlap area between the primary image and the auxiliary image. Ex. 1001, at 9:22–27. Patent Owner asserts that this disclosure means that the claims require

(1) different portions of the overlap region between the Wide and Tele images are treated differently based on differences of the relative positions and shapes of objects in the two images, meaning that pixels of one image cannot be simply translated to those of another image; and (2) identification of the primary image is necessary since the registration process must identify which objects (and pixels) must be included in the output image and which objects (and pixels) do not.

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PO Resp. 27–28 (citing Ex. 2005 ¶ 40). In fact, Patent Owner would require Border to “account or correct for *all* differences that occur between images with different points of view.” *Id.* at 28. Patent Owner also asserts, without citation to evidence, that “the required registration of the ’152 Patent is computationally more complex” than that of Border which Patent Owner describes as “simple planar homography.” *Id.* at 28. Patent Owner asserts that the ’152 patent requires “map[ping] only certain pixels of the Tele image which match the pixels of the Wide image.” *Id.* Patent Owner suggests that by designating a primary image the ’152 patent implicitly requires complex homography. *Id.* We do not find sufficient support for Patent Owner’s suggestion.

Neither Patent Owner nor its declarant cite to anywhere in the Specification or claims that disclaims translating pixels of one image into another or that explains this allegedly more complex registration. Additionally, neither Patent Owner nor its declarant cite to anywhere in the Specification or claims that requires all differences in points of view to be resolved in order to meet the claims. We cannot require the prior art to perform functions not required or explained in the Specification or the claims.

Additionally, Patent Owner admits that Border takes into account resolving the parallax artifacts that Patent Owner asserts are a limitation to the claims. *Id.* at 30. Patent Owner asserts this description of resolving parallax artifacts in Border is “substantively brief and unclear.” *Id.* at 31. Nevertheless, Patent Owner does not point to any explanation in the Specification or the claims of the ’152 patent of how such artifacts are resolved by the invention of the ’152

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patent. Additionally, Patent Owner asserts Border does not solve discontinuities over “the entire overlap area.” *Id.* We do not agree that the prior art must resolve all problems associated with having two cameras at differing points of view.

Patent Owner also asserts that the Petition uses Parulski as “a combination reference to shore up Border’s silence in discussing how a “primary image” is designated to be modified by a “non-primary image.” PO Resp. 32. Petitioner states correctly that “the Petition uses Parulski’s express “primary image” and “secondary image” labels to supplement Border’s teachings of establishing the primary/non-primary image relationship.” Reply 8. Thus, the Petition relies on Border’s discussion of how a “primary image” is designated to be modified by a “non-primary image,” albeit without using the words “primary” and “non-primary.” Nevertheless, we address Patent Owner’s arguments that Parulski’s registration technique cannot be combined with Border’s registration technique.

As to the combination of Border and Parulski, Patent Owner also asserts Border’s “simple planar homography” teaches away from Parulski’s more complex homography. PO Resp. 32–33. The fact that Parulski’s homography may be more complex does not support a teaching away. *Apple Inc. v. Samsung Elecs. Co.*, 816 F.3d 788, 801–02 (Fed. Cir.) (determining that a reference that called another reference more complex could nonetheless be combined for obviousness), *vacated in part on reh’g en banc on other grounds*, 839 F.3d 1034, 1051 n. 15 (Fed. Cir. 2016).

Patent Owner argues here, essentially, that one of skill in the art would choose a less complex alternative. Federal Circuit cases have

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recognized that the “mere disclosure of more than one alternative” does not amount to teaching away from one of the alternatives where the reference does not “criticize, discredit, or otherwise discourage the” solution presented by the disclosure. *SightSound Techs., LLC v. Apple Inc.*, 809 F.3d 1307, 1320 (Fed.Cir.2015) (internal quotation marks omitted) (quoting *In re Fulton*, 391 F.3d 1195, 1201 (Fed.Cir.2004)); *Allergan, Inc. v. Apotex Inc.*, 754 F.3d 952, 963–64 (Fed.Cir.2014).

Patent Owner asserts that Border would not be combined with Parulski for the purpose of designating primary and non-primary images because further modification to Border would be required to make the combination. Cite? Neither Border nor Parulski criticizes or discredits the other--in fact, Parulski incorporates Border. *See* PO Resp. 33. Border and Parulski merely describe different mechanisms for homography. Accordingly, we reject Patent Owner’s argument that Parulski teaches away from combining its teachings with those of Border.

Additionally, other than conclusory suggestions, Patent Owner does not support sufficiently an assertion that the modifications to Border would require undue experimentation. *See* PO Resp. 33. Thus, we are not persuaded by these arguments.

Patent Owner also argues that the Petition provides only a conclusory motivation to combine, i.e. that Border would implement Parulski’s homography to achieve “enhanced image quality.” PO Resp. 33. Nevertheless, according to Parulski, its techniques would result in “enhanced primary image” and Parulski explicitly incorporates Border as a reference that combines images. Ex. 1007,

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7:32–35, 29:51–58. Therefore, we are not persuaded that the Petition relies on motivation that is too conclusory. .

l) Summary

Based on the above contentions, on the complete record before us, we are persuaded that Petitioner has provided an articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *See KSR*, 550 U.S. at 418 (*citing In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). As a result, we are persuaded that the combination of Border and Parulski proposed by Petitioner is proper.

We are persuaded by Petitioner’s explanations and supporting evidence regarding independent claims 1 and 3. Based on the complete record before us, Petitioner has demonstrated preponderance of the evidence that independent claim 1 would have been obvious over Border and Parulski.

4. Analysis of Claims 2 and 4

Dependent claims 2 and 4 recite “wherein, if $FOV_2 \geq FOV_{ZF}$, then [the processor is further configured to/using the processor to] provide an output image from a point of view of the second camera.” Petitioner has shown sufficiently that Border teaches this limitation of claims 2 and 4. Petitioner contends Border teaches that when the zoom amount 210 Z equals the relative magnification ratio M (e.g., 3) of the telephoto image 206 to the wide image 204, the FOV_{ZF} defined by the zoom amount 210 Z is equal to FOV_2 , which teaches $FOV_2 \geq FOV_{ZF}$ as claimed. Pet. 63 (citing Ex. 1004 ¶ 144); Ex. 1006 ¶ 44. Petitioner’s declarant explains that, in the case where $Z = M$, a POSITA would have understood that FOV_{ZF} is defined by the zoom amount 210 Z and is equal to FOV_2 . Pet. 63–65 (citing Ex. 1004 ¶¶145–147); Ex. 1006 ¶ 44.

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Patent Owner asserts “[a]bsent from the Petition and the Cossairt declaration, however, is any evidence that Border teaches an output image from the point of view of the Tele camera when FOV_2 is **greater than** FOV_{ZF} .” PO Resp. 35 (citing Ex. 2005 ¶¶48–49) (emphasis added). Patent Owner cites to two non-precedential *ex parte* appeals cases using a means plus function analysis to a system claim for the proposition that Border must show the “structure for performing the functions should the conditions occur.” PO Resp. 36–37 (citing *Ex Parte Morichika*, Appeal No. 2014-000220, at 12–14 (PTAB April 5, 2017); *Ex Parte Conti*, Appeal No. 2016-001320, at 6 (PTAB Feb. 10, 2017), at 6. In other words, Patent Owner asserts that, in a limitation to greater than **or** equal to, prior needs to have structure that can an output image from the point of view of the Tele camera when FOV_2 is both “greater than” **and** “equal to.”

The claims at issue here are not means plus function claims. As to claims that are not means plus function, prior art does not have to meet all possible permutations of a conditional claim, but must only meet at least one valid permutation. *Ex Parte Schulhauser*, No. 2013-007847 slip op. at 9–10 (P.T.A.B. April 29, 2016) (precedential); J.A. 416 (emphasis added).

“When a claim covers several structures or compositions, either generically or as alternatives, the claim is deemed anticipated [or by extension deemed obvious] if any of the structures or compositions within the scope of the claim is known in the prior art.” *Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir. 2001) (citing *Titanium Metals Corp. of Am. v. Banner*, 778 F.2d 775, 782 (Fed. Cir. 1985)) (“*Brown*”).² Because we do not require

² See also *In re Theresa*, 720 F. App’x 634, 637 (Fed. Cir.), cert. denied sub nom; *Theresa v. Iancu*, 139 S. Ct. 230, 202 L. Ed. 2d 156 (2018) (citing *Brown*) (“claim 1 requires marking the labels with ‘pre-set words **or** pre-set

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the prior art to show an embodiment of “greater than” and a separate embodiment of “equal to” we are not persuaded by Patent Owner’s argument.

III. CONCLUSION³

For the foregoing reasons, we conclude that Petitioner has established by a preponderance of the evidence that claims 1–4 are unpatentable. In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–4	103	Border and Parulski	1–4	
Overall Outcome			1–4	

IV. ORDER

In consideration of the foregoing, it is hereby:

symbols’ . . . since Slater undisputedly disclosed the use of pre-determined words, claim 1 can be obvious in light of the prior art even without a reference to symbols.”) (emphasis added) (nonprecedential); *c.f. also CollegeNet, Inc. v. ApplyYourself, Inc.*, 418 F.3d 1225, 1232–33 (Fed. Cir. 2005) (finding a claim read as “one or more formats” can be infringed by a single specified format.)

³ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

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ORDERED that Petitioner has demonstrated by a preponderance of the evidence that claims 1–4 of the '152 patent are unpatentable; and

FURTHER ORDERED that because this is a Final Written Decision, any party to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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FOR PETITIONER:

David Obrien

Andrew S. Ehmke

Hong Shi

HAYNES & BOONE, LLP

David.obrien.ipr@haynesboone.com

Andy.ehmke.ipr@haynesboone.com

Hong.shi.ipr@haynesboone.com

FOR PATENT OWNER:

Neil Rubin

C. Jay Chung

Reza Miraie

RUSS AUGUST & KABAT

nrubin@raklaw.com

jchung@raklaw.com

mirzaie@raklaw.com